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Unresolved transitions in the nuclear γ-ray cascade produced in the decay of excited nuclei are best described by statistical concepts: a continuous radiative strength function (RSF) and level density yield mean values of transition matrix elements. Data on the soft ($E_\gamma < 3$–4 MeV) RSF for transitions between warm states (i.e. states several MeV above the yrast line) have, however, remained elusive [1].

A combination of two experiments on the same residual nucleus [2] can provide such data. This involves (i) deriving the level density and the sum (over all multipolarities) of all RSFs by sequential extraction from primary γ spectra [3] and (ii) measurements of two-step-decay spectra following neutron capture [4] which are roughly proportional to the product of two RSFs.

The very first two investigations (on ^{172}Yb and ^{57}Fe) have produced unexpected results. In the first case, a strong ($B(M1\uparrow) = 6.5\,\mu_{\rm N}^2$) resonance at $E_\gamma = 3.3$ MeV was identified. In the second case, a large (up to factor ~ 10) enhancement compared to theoretical estimates of the very soft ($E_\gamma \leq 3$ MeV), summed RSF for transitions between warm states was observed.

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1. Yu. P. Popov, Sov. J. Part. Nucl. **13** (1982) 483.
2. A. Voinov et al., Nucl. Instrum. Meth. **A497** (2003) 350.
3. A. Schiller et al., Nucl. Instrum. Meth. **A447** (2000) 498.
4. S. T. Boneva et al., Sov. J. Part. Nucl. **22** (1991) 698.